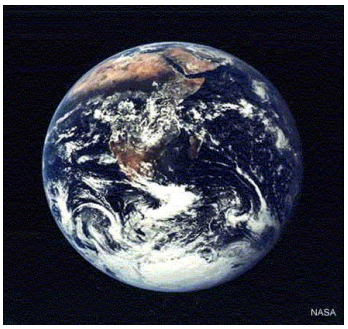
Geodynamics of the Earth and Planetary Interiors

Spring 2011 **Syllabus**- GEOL 595-GD/L
Meet Lecture: Tuesday/Thursday 10:00-10:50 am,
Lab: Tuesday/Thursday 11 – 12:15
LO Rm# 1221



Professor: Dr. Dayanthie Weeraratne
Email: dsw@csun.edu
Office hours: Tues &Thurs: 1:00–2:00 pm
Office: Live Oak Hall Rm# 1203 ext. 2046
Class webpage: http://www.csun.edu/~dsw/geodyn.htm

Required Text: Dynamic Earth, by Geoffrey Davies
Supplemental Text: Geodynamics by Turcotte and Schubert

Field Trip to Griffiths Park Observatory or JPL! Date TBA

Course Objectives: This course provides fundamental concepts necessary for understanding of the interior and surficial processes of the Earth and other planets through quantitative analysis of elastic plate flexure, heat flow, heat production, convection, geophysical fluid dynamics, gravity, surface stresses, and rheology and deformation of planetary materials. Geological areas of application include earthquakes, tectonic plate flexure, volcanic eruptions, magma plumbing, mountain building, mantle convection, Earth's interior heat budget, core dynamo, upper mantle flow and deformation mechanisms: applications to observed anisotropy. Designed for senior-level undergraduate and beginning graduate students in geology and/or geophysics.

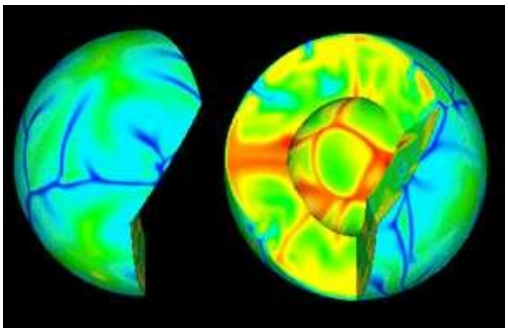


Figure to right: Numerical three dimensional model of convection in the Earth's mantle and core (Jeanloz et al., 2001). Here they test the hypothesis that iron-rich sediments float to the top of the outer core and create drag forces that throw off the Earth's wobble by a few millimeters over 18 years.

Tentative Course Outline:

Date/Week	Topic	Chapter (Davies)	(TS)
Jan 25	Introduction – Review of Quantitative Methods	1-4	1.1, 1.13
Jan 27	Plate Tectonics – Plates and the lithosphere	4.1, 9	1.2,4.15-4.17
Feb 1	Plate driving mechanisms, asthenosphere	10, 14.10	1.3-1.4
Feb 8	Stress and strain in solids	6.1-6.5	2.1-2.8
Feb 15	Plate bending and flexure	*lecture notes*	3.1-3.18
Feb 22	Mountain building, isostacy, gravity	4.2, 4.4, 6.9	1.7, 5.6-5.14
Mar 1	Heat Transfer – Conduction, geotherms, magmatic intrusions	7.1-7.1	4.1-4,4.7-8, & 4.19,4.27-29
Mar 8	Fluid Mechanics – 1D Couette (channel) flow, asthenosphere, aquifers, volcanic pipes (***student lectures***)	6.7	6.1-6.6
Mar 15	Fluid Mechanics - Conservation equations, Stokes flow, dimensional analysis	6.6	6.14,*notes*
Mar 22	Heat Transfer – Convection, heat budget, radioactive elements, mantle plumes	6.8, 7.4-7.9, 8, 14.1-14.9	4.5,6.15-6.22
March 29 -April 14	Flow in porous media – Darcy's law, permeability, magma migration, metal-silicate separation	*lecture notes*	9.1-9.12
April 5	***Spring Break***		
Apr 19	Crust & Mantle rheology – elasticity, viscoelasticity, plasticity, rheology effects on convection	6.10	7.1-7.11
Apr 26	Diffusion & dislocation creep, shear flows, stress dependent rheology	6.10	7.3-7.4
May 3	Dislocation creep guest lecture by Dr. Miranda		
May 10-12	Class project presentations and review		

Course Evaluation:

	Points
● 12 Reading reviews before each lecture (5 pts each)	60
● In class homework activities (5 pts each)	60
● 15 Minute Student Lecture (March 8-10)	15
● Midterm	100
● Final Exam	100
● Field trip to Griffith Park Observatory or JPL	30
TOTAL	365

Extra Credit:

● Participation in Salton Sea Experiment Seismic deployment	15

GEOL 595-Laboratory

Lab Evaluation:		Points
● 6 Labs (2 week duration), 20pts each		120
Individual Project (last 4 weeks)		
● Individual Project **Title**	Due: March 29	5
● Individual Project **Proposal** (paragraph or 1 page)	Due: April 5	10
● Written **Draft** for peer review	Due: May 5	
● Individual Project **Presentation** (10 minutes)	May 12	15
● Individual Project **Written Report** (last 4 weeks)	Due: May 12	70
TOTAL		220

Lab Project: You will be asked to pose a scientific question and use techniques learned in class such as numerical modeling, laboratory fluid dynamics, sandbox models, or other medium as a geodynamic model to answer the posed question. This may involve building a physical model or building a numerical code to study this phenomena. I will help you designing your project as well as assist with materials and building techniques. A draft and final written report of your project describing the problem, your experimental techniques, and findings will be due on the last day of class. The report should be 3-4 pages of text, double or single spaced (not including pictures or images) with an additional page for references.

Academic Dishonesty: I will follow the University's policy on **academic dishonesty** described in the Schedule of Classes**.** Cheating will result in a zero grade for an exam any assignment and notification to the Dean of Students which can result in disciplinary action. It also defeats your ability to learn and grow. Spend the time to figure it out. You might enjoy it!

Please be respectful to those around you in class. Inappropriate behavior will not be tolerated. Please **turn off all electronics** before coming to class (it's only an hour!).

Some tips for how to succeed in this class:

1. Ask, ask, ask questions, if you do not understand something or just to participate.
2. “Wherever you go, there you are...” - Be present in the moment. You can minimize study time if you **come to class** and give your **full attention**.
3. **Read** ahead and write down your questions. You'll enjoy it and be more engaged in the class.
4. Keep up with assignments and get them out of the way soon.
5. If you miss a lecture – **read** the material and get a copy of the notes.
6. If you don't do well on the first exam **ask for help** right away, don't put it off.
7. If you have questions or thoughts **come by during office hours**, we're here for **you**.
8. If something interests you, explore it! Life is short!